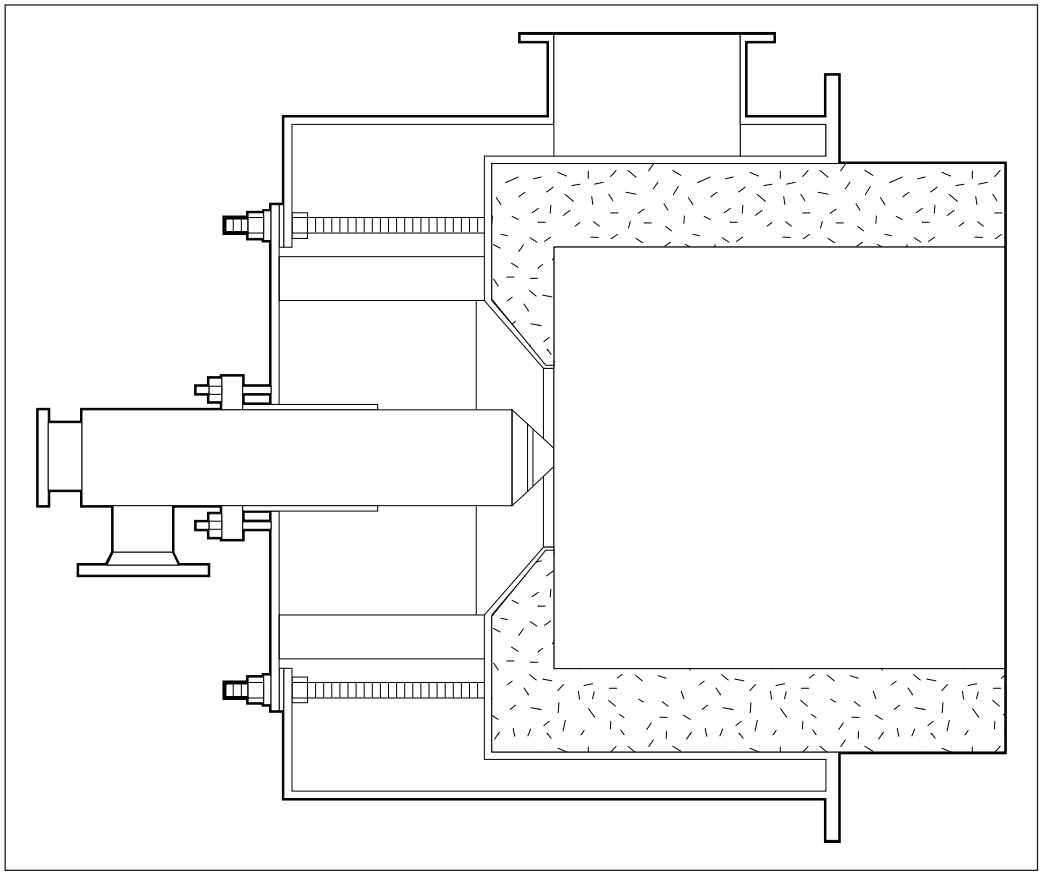
Installation Guide 248
4/10/07

Eclipse Vortometric Burners



ECLIPSE™
Innovative Thermal Solutions

Copyright

Copyright 1997 by Eclipse Combustion. All rights reserved worldwide. This publication is protected by federal regulation and shall not be copied, distributed, transmitted, transcribed or translated into any human or computer language, in any form or by any means, to any third parties, without the express written consent of Eclipse Combustion.

Disclaimer notice

In accordance with the manufacturer's policy of continual product improvement, the product presented in this brochure is subject to change without notice or obligation.

The material in this manual is believed adequate for the intended use of the product. If the product is used for purposes other than those specified herein, confirmation of validity and suitability must be obtained. Eclipse Combustion warrants that the product itself does not infringe upon any United States patents. No further warranty is expressed or implied.

We have made every effort to make this manual as accurate and complete as possible. Should you find errors or omissions, please bring them to our attention so that we may correct them. In this way, we hope to improve our product documentation for the benefit of our customers. Please send your corrections and comments to our Marketing Communications Manager.

Liability and warranty

It must be understood that Eclipse Combustion's liability for its products, whether due to breach of warranty, negligence, strict liability, or otherwise, is limited to the furnishing of replacement parts and Eclipse Combustion will not be liable for any other injury, loss, damage or expenses, whether direct or consequential, including but not limited to loss of use, income of, or damage to material arising in connection with the sale, installation, use of, inability to use or the repair or replacement of Eclipse Combustion's products.

About this manual

Audience

This manual has been written for those persons who are already familiar with all the aspects of a burner and its add-on components, also referred to as "the burner system". These aspects are:

- design/selection
- installation
- use
- maintenance

The audience is expected to have previous experience with this kind of equipment.

Scope

This manual provides information for installing the Vortometric burner ONLY and does not include the burner control system (such as fuel/air ratio controls, flame supervision systems, etc.). When Eclipse Combustion sells the burner as part of a complete package, then schematic piping and wiring diagrams will be furnished which explain the control system operation. When Eclipse Combustion sells only the Vortometric burner, then it is the purchaser's responsibility to ensure that:

- the control system is adequate for the application,
- the control system meets all applicable codes and regulations, and
- the operating personnel are fully familiar with safe control system operation.

Vortometric publications

Installation Guide No. 248
- This publication.

Data Sheets No. 248-1, 248-2
- Lists burner models information including dimensions.

Bulletin No. 248
- Used with Data Sheets to define burner specifications and available options.

Price Sheet No. 248
- Used to order burners.

Related publications

- EFE-825 (Combustion Engineering Guide)
- Eclipse Bulletins & Instruction Manuals: 818, 820, 826, 832, 852, 854, 856

Important notices

- Read this manual carefully. Make sure that you understand the structure and contents of this manual.
- Obey all the safety instructions.
- Do not deviate from any instructions or application limits in this manual without written consent from Eclipse Combustion.
- If you do not understand any part of the information in this manual, do not continue. Contact your Eclipse sales office or Eclipse Combustion.

Document conventions

There are several special symbols in this document. You must know their meaning and importance.

The explanation of these symbols follows. Please read it thoroughly.

Danger:
Indicates hazards or unsafe practices which WILL result in severe personal injury or even death.
Only qualified and well trained personnel are allowed to carry out these instructions or procedures.
Act with great care and follow the instructions.

Warning:
Indicates hazards or unsafe practices which could result in severe personal injury or damage.
Act with great care and follow the instructions.

Caution:
Indicates hazards or unsafe practices which could result in damage to the machine or minor personal injury.
Act carefully.

Note:
Indicates an important part of the text.
Read the text thoroughly.

Table of Contents

About this manual ..... *ii*

Table of Contents ..... *v*

1 **Introduction** *1-1*
Product Description *1-1*

2 **Safety** *2-1*
Introduction *2-1*
Safety *2-1*
Capabilities *2-2*
Operator Training *2-2*
Replacement Parts *2-2*

3 **Installation** *3-1*
Introduction *3-1*
Handling and Storage *3-1*
Position of Components *3-1*
Approval of Components *3-2*
- Limits controls and safety equipment *3-2*
- Electrical wiring *3-2*
- Gas piping *3-2*
- Where to get the standards *3-2*

Checklist before Installation *3-3*
Burner Mounting *3-4*
Prepare the Burner *3-2*
- Gas, Gas/Oil or Oil Gun Positioning *3-2*
- Install the flame sensor *3-7*
- Pilot *3-8*
- Piping *3-8*
- Strainers *3-10*
- Atomizing Control Methods *3-10*

Installing and Curing Refractory Block *3-11*
Checklist after Installation *3-14*

4 **Adjustment, Start & Stop** 4-1
Introduction 4-1
Adjustment Procedure 4-1
Step 1: Reset the system 4-1
Step 2: Set low fire combustion air pressure drop 4-2
Step 3: Verify air settings 4-2
Step 4: Ignite the pilot 4-2
Step 5: Ignite the burner 4-3
Step 6: Adjust low fire 4-4
Step 7: Adjust high fire 4-5
Step 8: Verify settings 4-5
Start Procedure 4-6
Stop Procedure 4-7

5 **Maintenance & Troubleshooting** 5-1
Introduction 5-1
Maintenance Schedules 5-1
Monthly Checklist 5-1
Yearly Checklist 5-2
Maintenance Procedures 5-2
Fuel Oil Tip Cleaning 5-2
Dismantling of Atomizer 5-4
Assembly of Atomizer 5-6
Troubleshooting 5-8

Appendix A-1
Flow and Input Charts A-1
Table A.1–Combustion Air Pressure Drop vs. Burner Heat Input for Medium Intensity Burners A-1
Table A.2–Combustion Air Pressure Drop vs. Burner Heat Input for High Intensity Burners A-2
Table A.3–Gas Gun Press. Drop vs. Burner Heat Input A-3
Table A.4–Oil Nozzle Press. Drop vs. Burner Heat Input A-4
Table A.5–Atomizing Air Press. Drop vs. Air Flow A-4
Table A.6–Atomizing Steam Press. Drop vs. Steam Flow A-5
Recommended Spare Parts A-5
Conversion Factors A-6
System Summary A-7

Introduction

1

PRODUCT DESCRIPTION

The Eclipse Vortometric v2.00 is a dual-fuel, high intensity burner which operates at maximum efficiency whether firing fuel oils or natural, propane, butane, manufactured or other mixed gases.

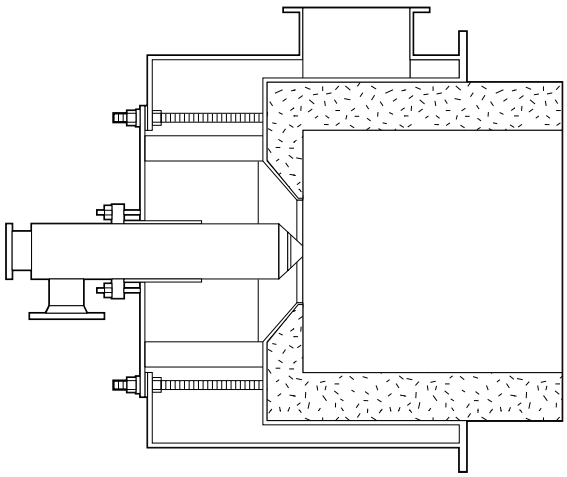
The Vortometric's versatility and rugged design make it the right choice for any heating process, including driers, kilns, thermal fluid heaters, thermal oxidizers, oil heaters, vaporizers, boilers, liquid and waste incineration, and many air heating applications.

The high combustion air swirl rate produced by the Vortometric burner results in a stable flame with high turndown capabilities on a wide range of fuels. The burner can be operated with low excess air where maximum efficiency is required or high excess air for high volume process air heating. The intense and thorough mixing of the air and gas results in low NOx and CO emissions.

The novel design of the oil atomizer uses shear forces and acoustical energy created by a "vortex generator" to vaporize the fuel for clean, smoke-free combustion.

Vortometric v2.00 burners are available with capacities of 6mmBtu/hr. to 210mmBtu/hr. Low combustion air pressure is used (7.5"w.c.) with all sizes and atomization of the fuel oil can be by steam, air, or any gaseous fuel.

Figure 1.1 **Vortometric v2.00 Burner**



Safety

2

INTRODUCTION

In this section, you will find important notices about safe operation of a burner system.

SAFETY

Danger:

The burners covered in this manual are designed to mix fuel with air and burn the resulting mixture. All fuel burning devices are capable of producing fires and explosions when improperly applied, installed adjusted, controlled, or maintained.

Do not bypass any safety feature.
You can cause fires and explosions.

Never try to light the burner if the burner shows signs of damage or malfunctioning.

Warning:

The burner and duct sections are likely to have HOT surfaces. Always wear protective clothing when approaching the burner.

Note:

This manual gives information for the use of these burners for their specific limited design purpose. Do not deviate from any instructions limits in this manual without written advice from Eclipse Combustion.

Note:

Read this entire manual before you attempt to start the system. If you do not understand any part of the information in this manual, then contact your Eclipse representative or Eclipse Combustion before you continue.

Capabilities

Adjustment, maintenance and troubleshooting of the mechanical and the electrical parts of this system should be done by qualified personnel with good mechanical aptitude and experience with combustion equipment.

Operator training

The best safety precaution is an alert and competent operator. Thoroughly instruct new operators so they demonstrate an adequate understanding of the equipment and its operation. Regular retraining must be scheduled to maintain a high degree of proficiency.

Replacement parts

Order replacement parts from Eclipse only. Any customer-supplied valves or switches should carry UL, FM, CSA, CGA and/or CE approval where applicable.

Installation

3

Introduction

In this section you will find the information and instructions that you need to install the burner.

Handling and storage

Handling

1. Make sure that the area is clean.
2. Protect the components from the weather, damage, dirt and moisture.
3. Protect the components from excessive temperatures and humidity.
4. Take care not to drop or hit components.

Storage

1. Make sure that the components are clean and free of damage.
2. Store the components in a cool, clean, dry room.
3. After you have made sure that everything is present and in good condition, keep the components in the original package as long as possible.

Caution:
When the refractory combustion block is supplied with the burner, it is critical that the instructions for handling and storage are followed. The refractory should be considered fragile; improper handling and storage will cause premature failure.

APPROVAL OF COMPONENTS

Limit controls and safety equipment

All limit controls and safety equipment must comply with the following current standards:

- NFPA Standard 86
- NFPA Standard 86C
- UL
- FM
- CGA
- CSA
- EN 746-2
- all applicable local codes and/or standards.

Electrical wiring

All of electrical wiring must comply with the one of the following standards:

- NFPA Standard 70
- ANSI-C11981
- CSA
- EN 746-2
- the electrical wiring must be acceptable to the local authority having jurisdiction.

Gas piping

All of the gas piping must comply with the one of the following standards:

- NFPA Standard 54
- ANSI Z223
- EN 746-2
- the gas piping must be acceptable to the local authority having jurisdiction.

Where to get the standards

The NFPA Standards are available from:

National Fire Protection Agency
Batterymarch Park
Quincy, MA 02269

The ANSI Standards are available from:

American National Standard Institute
1430 Broadway
New York, NY 10018

The UL Standards are available from:

United Laboratories
333 Pfingsten Road
Northbrook, IL 60062

The FM Standards are available from:

Factory Mutual
1151 Boston-Providence Turnpike
P.O. Box 9102
Norwood, MA 02062

The CGA Standards are available from:

Canadian Gas Association
55 Scarsdale Road
Toronto, Ontario
Canada M3B 2R3

The CSA Standards are available from:

Canadian Standards Association
178 Rexdale Boulevard
Etobicoke, Ontario
Canada M9W 1R3

Information on the EN standards, and where to get the standards is available from:

Comité Européen de Normalisation
Stassartstraat 36
B-1050 Brussels
Phone: +32-25196811
Fax: +32-25196819

Comité Européen de Normalisation Electronique
Stassartstraat 36
B-1050 Brussels
Phone: +32-25196871
Fax: +32-25196919

CHECKLIST BEFORE INSTALLATION

Access

Make sure that you install the system in such a way that you can get easy access to the burner for inspection and maintenance.

Environment

Make sure that the local environment matches the original operating specifications. Check the following items:

- voltage, frequency and stability of the electrical power
- type and supply pressure of the fuel
- availability of enough fresh, clean combustion air
- humidity, altitude and temperature of air
- presence of damaging corrosive gases in the air.

BURNER MOUNTING

Depending on your application, please keep the following in mind when mounting a burner:

- Ensure that the burner is level and that the furnace or burner casing has sufficient rigidity to support the burner. If necessary, provide stiffeners on the casing or supports under the burner.
- Remember to compensate for the burner's combustor liner extension for the refractory combustion block.
- Use gasketing between the burner mounting flange and the furnace casing and ensure that you have a gas-tight joint between these two surfaces. This tightness is especially critical for systems operating under positive pressures.

PREPARE THE BURNER

There are several components that must be installed to a burner systems before it can operate. Instructions to do that follow below.

Gas, Gas/Oil or Oil Gun Positioning

Prior to starting the burner, the gun position in relation to the burner throat cone must be checked.

Note:
Burners are not necessarily shipped with guns in the correct position; it is also possible that the gun could shift during shipment.

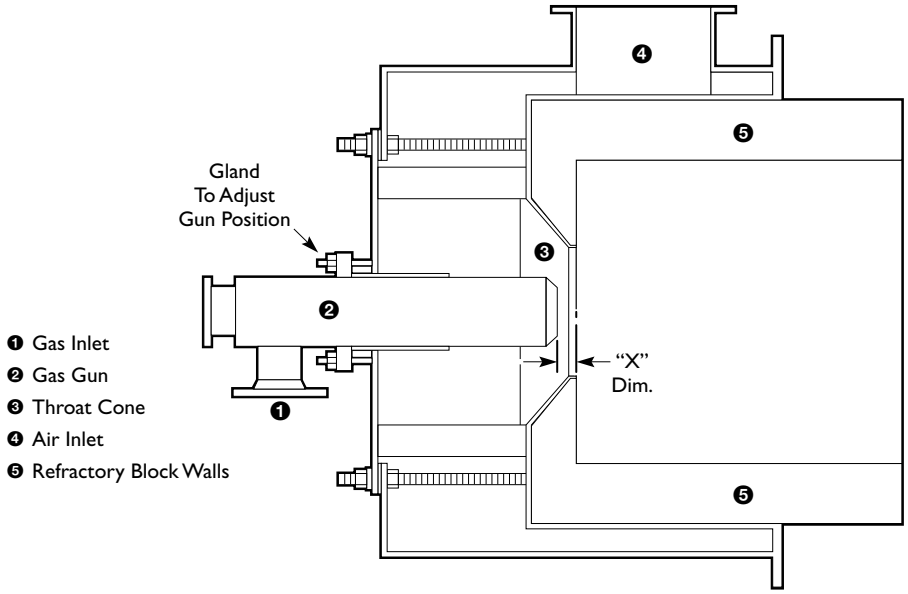
Note:
All of the following adjustments provide a relative position for safe operation for all applications; occasionally, adjustments in or out from the relative positions may be necessary depending on your application.

For Gas Only Burners *(see Figure 3.1)***:**

1. To adjust the gas gun, loosen the gland.
2. Using the chart in Figure 3.1, determine the "X" dimension based on your burner size.
3. Once the "X" dimension is verified and the gas gun is centered in relation to the throat cone, tighten the gland.

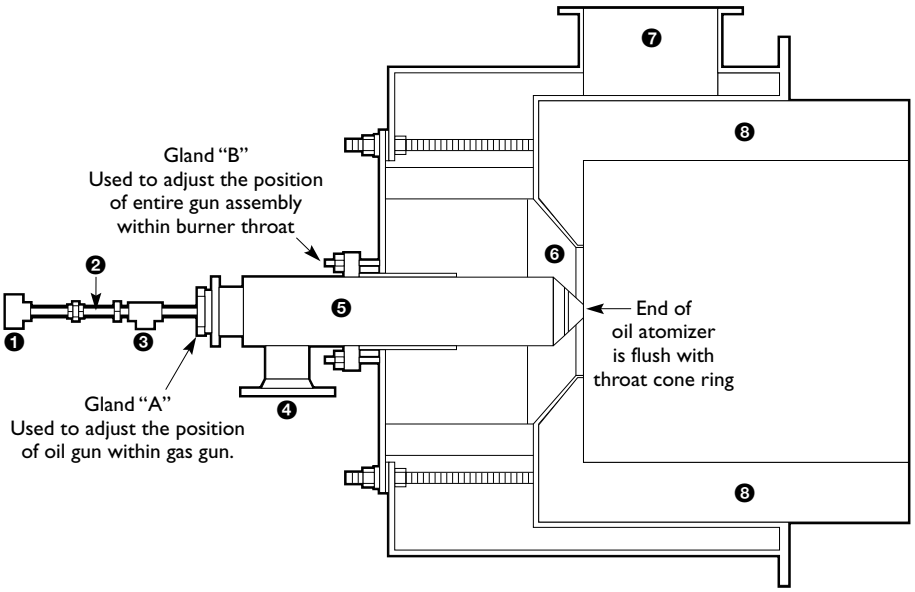
Note:
Failure to center the gun in the burner throat will cause uneven air flow and flame instability. The gun should be centered with +/- 1/8".

Figure 3.1 Vortometric Gas Gun Position



Burner Size	"X" (Inches)
6V	11/16
8V	1-3/8
10V	1-5/16
12V	1-1/2
14V	1-11/16
16V	2-1/16
18V	2
22V	2-5/16
24V	2-1/4
28V	3-3/16
32V	3-1/16
36V	3-7/8

Figure 3.2 Vortometric Gas/Oil Gun Position



For Combination Gas/Oil Burners–Initial Adjustment *(see Figure 3.2)***:**

1. Adjust the oil gun position by loosening gland "A".

2. Align the conical faces of the oil and gas guns.

3. Once both guns are aligned, tighten gland "A" on the oil gun.

Note:
After this initial adjustment, all subsequent adjustments for combination gas/oil burners require that both guns be moved as a single unit.

For Combination Gas/Oil Burners–Subsequent Adjustments *(see Figure 3.2)***:**

1. Adjust the entire gas/oil gun assembly by loosening gland "B".

2. Move the entire gun assembly until the oil nose cone aligns with the small diameter of the throat cone.

3. Once both cones are aligned and the gas gun is centered in relation to the throat cone, tighten gland "B".

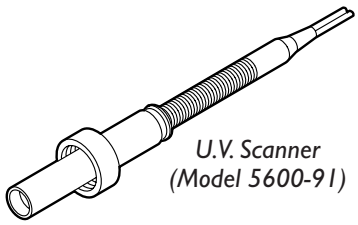
For Oil Only Burners *(see Figure 3.2)***:**

1. Adjust the oil gun position so that the end of the oil nose cone aligns with the small diameter of the throat cone as shown at left.

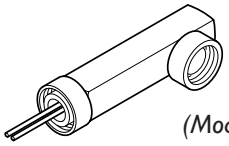
2. Verify that the oil gun is centered in relation to the throat cone; once verified, tighten the large gland nuts.

Note:
Failure to center the gun in the burner throat will cause uneven air flow and flame instability. The gun should be centered with +/- 1/8".

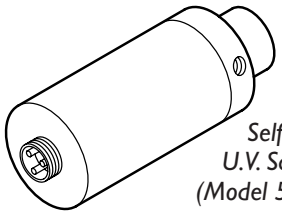
Install the flame sensor



U.V. Scanner (Model 5600-91)



90° U.V. Scanner (Model 5600-90A)



Self-Check U.V. Scanner (Model 5602-91)

An ultraviolet flame sensing device, or U.V. scanner, must be used with a 3/4" N.P.T. swivel connector. The scanner and connector can be used in three possible locations: two mounting ports are located near the gun assembly adjacent to the pilot which sight both pilot and main flames, while a third mounting port on the side of the combustor sights only the main flame. Flame detection methods are affected by fuels and applications:

- For gas, light oil, or heavy oil with air atomization, locate a U.V. scanner in one of the two mounting ports near the pilot to prove pilot and main flames.
- For heavy oil with steam atomization, two scanners must be used. Because atomizing steam absorbs ultraviolet light, a scanner mounted near the pilot will only prove the pilot flame. Therefore, a second scanner mounted on the combustor side is needed to prove the main flame.

Note:
Due to the low U.V. content of oil flames, some U.V. scanner/ flame safety systems may have difficulty sighting oil flames at high inputs. In these cases, a more sensitive U.V. detector may be required or an infrared (I.R.) detector may be used.

Make sure that you connect the flame sensor of a burner to the electrical circuit of the burner.

Danger:
If you connect the flame sensor of a burner to the electrical circuit of the wrong burner, then you can cause fires and explosion.

For detailed information on how to install and connect a U.V. scanner, refer to:

- straight U.V. scanner; Bulletin/Instruction Manual 854
- 90° U.V. scanner; Bulletin/Instruction Manual 852
- self-check U.V. scanner; Bulletin/Instruction Manual 856.

Pilot

Pilot ignition

The standard Vortometric spark-ignition pilot requires an ignition transformer with a minimum of 6000 volt secondary. Mount the transformer in a location where it will not overheat while allowing as short an ignition lead as possible.

Pilot assembly positioning

The relation of the pilot assembly to the main burner gun affects air flow through the throat cone. Therefore, it is important that the pilot be as far away as possible from the throat cone while maintaining reliable ignition. For initial start-up, the pilot assembly should be between 6" and 8" away from throat cone; if necessary, adjust the pilot assembly gland to achieve this distance.

Piping

Support the piping and ductwork

Use brackets or hangers to support the piping and ductwork to avoid placing undue loads on the burner. If you have questions, consult your local gas company.

Pipe connections

The use of flexible pipe in gas, oil and atomizing air lines to the burner is recommended. Adjustments of the main gas, pilot gas and oil guns may be required during burner setup.

Avoid large pressure drops

Note:
The pressure drop of the gas in the piping is a critical parameter. Make sure that the size of all the piping is large enough to prevent excessive pressure losses.

Oil fuel considerations

1. In heavy oil (#5 or #6) applications, the oil temperature at the burner inlet should be 220° to 270°F for good viscosity (maximum 150 SSU). Depending on burner location, steam or electric tracing AND pipe insulation are usually needed to ensure this oil temperature range. Other oils (wastes, residues, etc.), may also require similar provisions to ensure good viscosity.
2. Foreign material can easily clog the small injection holes in the oil nozzle tip. Therefore, ensure that all inside surfaces of assembled piping to the burner are free of dirt, grit, shavings or any other foreign material. To avoid contamination, use thread sealants such as Teflon paste only on pipe threads that will not come in contact with the oil flow.
3. A purge of the oil nozzle should be conducted after burner shutdown. To do so, connect a line between the atomizing medium and the oil piping just upstream of the oil nozzle, and install check valves in this line and the oil piping.

Atomizing steam considerations

1. Atomizing steam must be dry and superheated to at least 20°F above saturated at the burner inlet. Therefore, this piping line must be insulated up to the burner inlet. Provisions must also be made for continuous condensate disposal via a steam trap and drain.

Compressed air considerations

1. When compressed air is used for atomization, it is possible for water and oil vapor from the air compressor to contaminate the atomizer. Therefore, include preventative measures against this possibility when designing the air distribution system.
2. ALL compressors should be equipped with a suitable aftercooler, oil separator, and automatic traps or drain valves.
3. When compressed air is used for atomization of heavy oils (#5 or #6), preheat the air to a temperature between 220° and 270°F and insulate the air lines.

Pilot gas considerations

1. ALL supplied gas pilot piping (natural, propane, etc.) MUST be fitted with a pilot gas pressure regulator.
2. ALL supplied gas pilot piping (natural, propane, etc.) SHOULD BE fitted with an adjustable orifice valve for pilot gas flow adjustment.

Strainers

No matter what fuel is used, it is essential that the valve train components, the atomizer and the fuel oil tip be protected from foreign material damage. Therefore, it is suggested that strainers be used as follows:

Oil valve trains

1. It is recommended that an edgeplate type filter with 0.0035" separations (170 mesh) be used UPSTREAM of all valve train components.
2. It is recommended that a strainer with 100 mesh screen be used ADJACENT to the oil gun inlet.

Atomizing valve trains

It is recommended that a strainer with 1/32" diameter perforated or 20 mesh screen be used UPSTREAM of all valve train components for steam or compressed air applications.

Fuel gas valve trains

It is recommended that a strainer with 1/32" diameter perforated or 20 mesh screen be used UPSTREAM of all valve train components.

Atomizing control methods

There are two possible control methods for atomizing air and steam:

1. **Fixed:** If the burner's turndown ratio requirement does not exceed 5:1, then the atomizing pressure at the burner may be set to run constantly at 50/55 psig, eliminating the need for a differential pressure regulator.
2. **Modulating:** Use a differential pressure regulator which is "top loaded" with the oil pressure at the nozzle, which allows the atomizing pressure to increase proportionally with the oil pressure. To do so, set the atomizing pressure approximately 20 psig above the oil pressure, but not exceeding 50/55 psig. To ensure this maximum pressure is not exceeded, adjust the pressure regulator for the incoming atomizing supply to not exceed 50/55 psig.

INSTALLING AND CURING REFRACTORY BLOCK

It is the customer's choice whether the combustion refractory block is factory or field installed. The following provisions deal with installing either choice. The standard, general purpose refractory for Vortometric combustor blocks is Plibrico 80 Air Bond with an 80% alumina plastic ramming mix.

Factory installed refractory

The Eclipse factory installed refractory has been oven cured at relatively low temperatures to remove most of the water content. However, some residual water may still be present and must be removed at the initial start-up.

After the burner and refractory have been installed, the following steps will ensure proper curing and maximum strength to reduce chances of cracking or spalling:

1. Set the combustion air at its minimum input.
2. Light only the pilot and leave on for approximately three hours.
3. After three hours, light the main burner at the minimum input.
4. Increase the heat input by 150°F per hour.
5. Water evaporation (steam) is usually heaviest and most prominent around 1,000°F. If steam is still prevalent after the hour at 1,000°F, hold at that temperature for two to three more hours or until the steam stops.

Caution:
If at anytime during the curing process visible steam rises from the refractory, hold the temperature until it dissipates.

6. Once steam stops coming from the refractory, assume the 150°F temperature rise per hour until you reach 2,000°F.
7. Hold at 2,000°F for three to four hours to ensure proper curing.

Field installed refractory

The customer is responsible for supplying all refractory materials for field installation as follows:

1. Cover the inside surfaces of the combustor shell with an 1/8" layer of Plibrico "Plisulate" fibrefax paper or equivalent.
2. Install alloy anchors in the combustor shell according to the refractory supplier's recommendations. The alloy anchors should be coated with bitumastic wherever they protrude through the layer of Plibric Plisulate.
3. Install the chosen refractory, realizing it is essential that:
   - the combustion block dimensions are held as given on Eclipse drawings
   - the inside diameter of the combustion block ***be concentric with the air cone in the burner***.

   Refer to Figure 3.3 for wall interface, and typical refractory installation details and recommendations.
4. The refractory should then be pounded into place with a pneumatic rammer, starting around the air cone. Use care in ensuring that the specified contours and dimensions on the aforementioned Eclipse drawing are maintained. Provide vent holes so moisture can escape during dry-out.

Note:
The corner angle between the cone and the sidewall must be 90° or slightly less, but NOT MORE.

After the burner and refractory have been installed, the following steps will ensure proper curing and maximum strength to reduce chances of cracking or spalling:

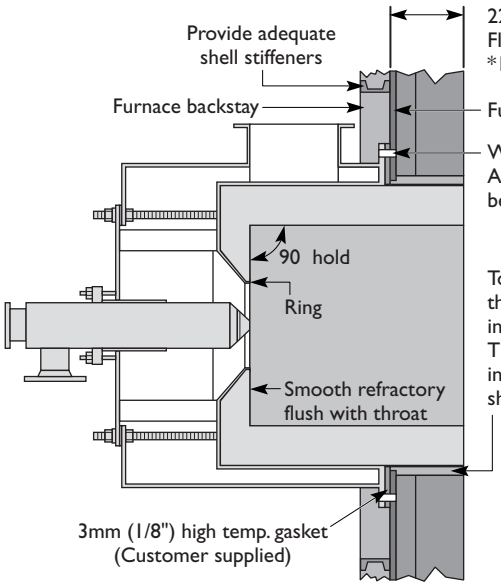
1. Set the combustion air at its minimum input.
2. Light only the pilot and leave on for approximately three hours.
3. After three hours, light the main burner at the minimum input.
4. Increase the heat input by 100°F per hour.
5. Water evaporation (steam) is usually heaviest and most prominent around 1,000°F. If steam is still prevalent after the hour at 1,000°F, hold at that temperature for two to three more hours or until the steam stops.

Caution:
If at anytime during the curing process visible steam rises from the refractory, hold the temperature until it dissipates.

6. Once steam stops coming from the refractory, assume the 100°F temperature rise per hour until you reach 2,000°F.
7. Hold at 2,000°F for three to four hours to ensure proper curing.

Figure 3.3 Vortometric Burner Mounting Arrangements

Suggested Mounting Arrangement For Standard Burner



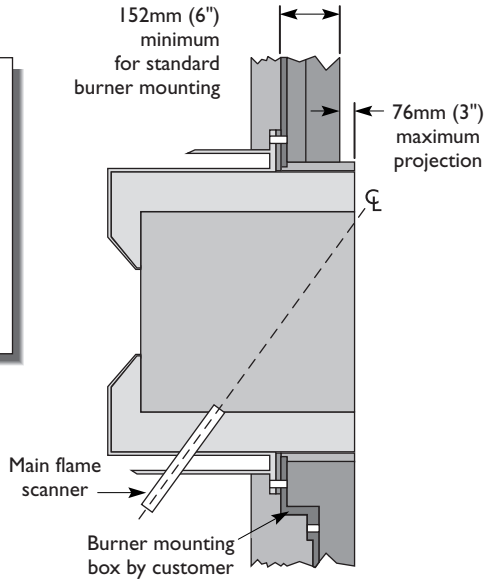
229mm (9")*
Flange position on standard burner allows correct shell dimension above *178mm (7") for 6V and 8V medium intensity burner sizes.

Furnace shell plate

Weld heads of mounting bolts inside furnace shell plate. Allow for 3mm (1/8") thick, high temperature gasket between the burner flange and shell plate.

To allow for thermal expansion of combustion liner extension, the main wall should be constructed with an opening 25mm (1") greater in diameter than diameter of combustion liner.
The outside of combustion liner should be covered with 1/8" thick insulating paper. The remaining gap between the burner and main wall should be densely packed with ceramic fiber or wool blanket insulation.

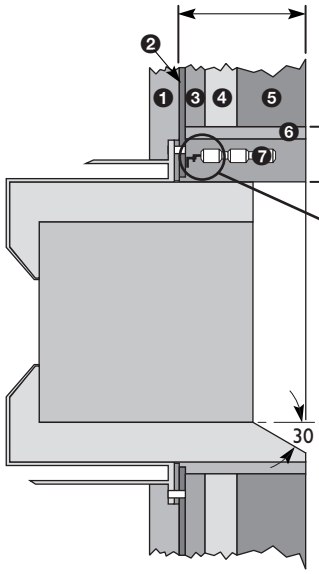
Alternate Mounting Arrangement For Thin Walls


152mm (6") minimum for standard burner mounting
76mm (3") maximum projection
℄
Main flame scanner
Burner mounting box by customer

General Notes:

1. Mounting illustrations show typical Vortometric combustor blocks of high alumina plastic refractory as used by Eclipse for normal duty.
2. The dimensions given must be held as specified, and the inner diameter of the combustor must be round and concentric with the throat cone.
3. Alloy rod-type anchors welded inside the combustor block are the customer's responsibility if the refractory is field installed rather than factory installed.
4. All mounting arrangements are meant for vertically or horizontally fired burners. Regardless of orientation, the refractory block MUST be protected from thermal expansion of the furnace wall.

Alternate Mounting Arrangement For Thick Walls



❶ Furnace Backstay
❷ Furnace Shell Plate
❸ Block Insulation
❹ Insulated Fire Brick
❺ Fire Brick
❻ Castable Refractory Ring (Alternate Plastic)
❼ Refractory or Alloy Anchor (305mm to 457mm or 12" to 18" apart)

CHECKLIST AFTER INSTALLATION

To make sure that the system is installed correctly, do the steps that follow:

1. Make sure that there are no leaks in the gas lines.
2. Make sure that the blower rotates in the correct direction. If incorrect, then have a qualified electrician rewire the blower to reverse its rotation.
3. Set the air proving switch.
4. Set the low gas pressure switch.
5. Set the high gas pressure switch.
6. Close all the burner gas cocks.
7. Trip out pressure switches and other limit interlocks. Make sure that the main gas valves close.

Danger:

If simulated limits or simulated flame failures do not shut down the fuel system within the required failure response time, then immediately correct the problem.

Adjustment, Start & Stop

4

Introduction

In this chapter you will find instructions on how to adjust a system and how to start and stop a system.

Danger:
Do not bypass any safety features. You can cause fires and explosions.
Obey the safety precautions in the Safety chapter.

Read all of this chapter before starting your system.

Adjustment procedure

If you are adjusting the burner system for the first time, then you must follow these steps:

1. Reset the system

2. Set combustion air pressure drop

3. Verify the air settings

4. Ignite the pilot

5. Ignite the burner

6. Set low fire fuel flow

7. Set high fire fuel flow

8. Verify the settings

Step 1: Reset the system

Close the automatic gas valves and the gas cocks.

Step 2: Set low fire combustion air pressure drop

1. Start the combustion air fan.
2. Set the air control damper to produce the desired pressure drop across the burner. Air pressure drop should be read as a differential pressure between the windbox pressure test port and the chamber. See the combustion air pressure drop versus air flow curves (Tables A.1 and A.2 in the Appendix).

Step 3: Verify air settings

Make sure that all the settings are still the same after you cycle the system several times between high fire and low fire. Check air proving switch and adjust if necessary.

Note:
Test spark ignitor with a visual or audible check before attempting ignition.

Step 4: Ignite the pilot

1. Set system to operate on pilot only. See the literature included with the flame monitoring relay.
2. Set pilot regulator to 6"w.c. outlet pressure.
3. Open the pilot adjusting valve two turns.
4. Initiate start sequence and ignite the pilot.

Note:
Initially it may be necessary to repeat step 4 two or three times to purge air out of the gas pipework.

5. Trim pilot with adjustable gas cock to obtain pressure drops of:
   - 1.5" to 2.0"w.c. for natural gas
   - 0.6" to 0.9"w.c. for propane, butane

   Refer to Table 4.1 at left for pilot input capacities. Pressure drop is differential between pilot gun inlet and chamber.

Note:
The pilot flame should be a bushy, blue flame which curls around the main gas/oil gun nozzle. This flame should provide a stable pilot with good flame signal readings sufficient to energize the main gas valve.

6. If necessary, adjust the position of the U.V. scanner to ensure good pilot flame detection.

Table 4.1 **Pilot Capacities**

Burner Size	Input (Btu/hr.)	
	Main Burner	Pilot
6V	6,000,000	60,000
8V	10,500,000	105,000
10V	17,000,000	170,000
12V	23,000,000	230,000
14V	32,000,000	320,000
16V	42,000,000	420,000
18V	55,000,000	550,000
22V	78,000,000	780,000
24V	90,000,000	900,000
28V	125,000,000	1,250,000
32V	160,000,000	1,600,000
36V	210,000,000	2,1000,000

Step 5: Ignite the burner

Note:
This procedure assumes that automatic flame safety is installed and is serviceable.

For Gas Burners

1. Make sure the supply air fan is running.
2. Adjust the main gas regulator to supply the minimum pressure required; see the Appendix for gas pressure drop information.
3. Verify that the main gas control valve is at its minimum open position.
4. Light the pilot.
5. Open all manual fuel shut-off valves.
6. Initiate the ignition sequence through the flame safety.
7. Check that the pilot and main burner flames have ignited.
8. The gas flame should be a pale blue color set inside the refractory combustion block.

Note:
Combination gas/oil burners may be operated on gas with the oil gun in place provided that the atomizing medium is left on at a minimum pressure of 5 to 10 psig. When shutting down, leave the atomizing medium on until the block and combustion chamber are cool.

Combination gas/oil burners may also be operated with the oil gun and oil gun gland removed; see Figure 3.2 on page 3-5 for gland "A" identification and location. When doing so, a blanking plate must be substituted for gland "A" at the rear of the gas gun.

For Oil Burners

1. Make sure the supply air fan is running.
2. Adjust the main oil regulator to supply the minimum pressure required; see the Appendix for oil nozzle pressure drop information.
3. Turn on the atomizing medium and adjust atomizing pressure to approximately 20 to 30 psig.

Note:
If using heavy oil as the fuel with either steam or preheated air for atomization, then warm up the oil feed pipe and fuel oil nozzle by running the atomizing medium through the burner bypass valve. Leave this bypass valve open for 5 to 10 minutes.

4. If steam is being used for atomization, allow plenty of time to drain the system of accumulated condensate and ensure steam traps are working.
5. Verify that the main oil control valve is at its minimum open position.
6. Light the pilot.
7. Open all manual fuel shut-off valves.
8. Initiate the ignition sequence through the flame safety.
9. Check that the pilot and main burner flames have ignited.
10. The oil flame should be a bright yellow color set inside the refractory combustion block.

Step 6: Adjust low fire

Note:
The first time that the burner is started, allow the refractory combustion block to warm up slowly to reduce thermal shock. Refer to "Installing and Curing Refractory Block" in Chapter 3 for details.

If necessary, adjust the main control valve's minimum open position to obtain the desired low fire setting.

Step 7: Adjust high fire

For Gas Burners

1. Drive the main gas control valve to high fire.
2. Measure the gas pressure drop at high fire and compare to the appropriate chart in the Appendix. If the maximum input is not

achieved or is too high while the main gas control valve is fully open, two adjustments can be made:

a. the main gas control valve can be adjusted open or closed, or

b. the main gas pressure regulator can be adjusted higher or lower.

3. The main gas flame should have a slightly blue periphery and a somewhat yellowish center at high fire; refer to Table 4.2 below for flame length estimates.

For Oil Burners

1. Drive the main oil control valve to high fire.

2. Measure the oil pressure drop at high fire and compare to the appropriate chart in the Appendix. If the maximum input is not achieved or is too high while the main oil control valve is fully open, two adjustments can be made:

a. the main oil control valve can be adjusted open or closed, or

b. the main oil pressure regulator can be adjusted higher or lower.

3. Note the atomizing air pressure. If modulating control is used, the atomizing pressure should be approximately 20 psig above the oil pressure without exceeding 50/55 psig.; refer to "Modulating Control" on page 3-10 for further details.

4. The high fire oil flame should be bright yellow; refer to Table 4.2 below for flame length estimates.

Step 8: Verify settings

1. Once the high and low fire conditions have been set, cycle the burner from high to low fire several times to check repeatability of settings.

2. Shut down the burner and relight to ensure automated pilot and main flame ignition operates correctly.

3. Check all safety interlocks and limits to ensure proper operation.

Table 4.2 Flame Sizes

Burner Size	Burner Input (MMBtu/hr.)	MI or HI* Flame Dia. (in.)	Flame Length (ft.)	
			MI* Burner	HI* Burner
6V	6.0	30	6.0	5.0
8V	10.5	32	7.0	6.0
10V	17.0	36	8.0	7.0
12V	23.0	40	9.0	8.0
14V	32.0	46	10.5	9.0
16V	42.0	52	12.0	10.0
18V	55.0	58	13.0	11.0
22V	78.0	64	15.0	13.0
24V	90.0	68	16.0	14.0
28V	125.0	78	18.0	16.0
32V	160.0	86	20.0	17.0
36V	210.0	96	24.0	20.0

* MI means Medium Intensity and HI means High Intensity.

Note:
Flame lengths are measured from the open end of the combustor.

Flame lengths are estimates based on general operating conditions and are useful for design purposes. Actual flame lengths will depend on chamber size and presence of secondary air.

START PROCEDURE

1. Start the air supply fan.
2. Open all the gas or oil cocks.
3. Start the automatic ignition sequence.

Danger:

If a burner does not light, and the system does not shut down automatically, then you must close the main gas cock on gas burner systems. An uncontrolled flow of gas can cause fires and explosions.

Do not touch the ignition plug or the ignition wire when the ignition is on. You will get a shock.

4. Make sure that you can see the flame in the burner system.

If the burner system does not light and

- **the system does not shut down automatically:** then close the main gas or oil cock manually. DO NOT operate the system. Go to "Checklist after Installation" on page 3-8 and verify the steps. After that, repeat the start procedure.
- **the system shut downs automatically:** then see the "Trouble-shooting" Tables in the next chapter.

STOP PROCEDURE

For Gas Burners

1. Drive combustion air and gas valves to low fire position.
2. Shut off main gas supply valves and pilot.
3. Leave combustion air at low fire until combustion chamber and block are cooled; once cooled, shut off combustion air fan.
4. Shut off all manual valves as required.

For Oil Burners

1. Drive combustion air and fuel valves to low fire position; shut down the oil supply.
2. Turn on the pilot.
3. Purge the oil nozzle with the atomizing medium through the bypass connection valves.
4. When the oil nozzle is clear of oil, then turn off the pilot.
5. Leave combustion air and atomizing medium on until the combustion chamber and block are cooled; once cooled, shut off the combustion air and atomizing medium supplies.
6. Shut off all manual valves as required.

Maintenance & Trouble-shooting

5

Introduction

This section is divided into two parts:

- The first part describes the maintenance procedures.
- The second part helps you to identify problems that may occur, and gives advice on how to solve these problems.

Maintenance schedules

Preventative maintenance is the key to a reliable, safe and efficient system. The following are sugested guidelines for periodic maintenance. Burners in severe environments or operational conditions should be checked more frequently.

Note:
The monthly and yearly lists are an average interval. If your environment is dirty, then the intervals may be shorter. Check with local authorities having jurisdiction on their recommended maintenance schedules.

Caution:
Turn off power to burner and controls before proceeding with burner inspection.

Monthly Checklist

1. Inspect flame-sensing devices for good condition and cleanliness.
2. Test all alarms for proper signals.
3. Check ignition spark electrode operatin and check proper gap.
4. Check all valve motors and control valves for free, smooth action and adjustment.
5. Test interlock sequence of all safety equipment and manually make each interlock fail, noting that related equipment closes or stops as specified by the manufacturer. Test flame safeguard by manually shutting off gas to burner.
6. Test all manual fuel valves for operation.
7. Check filters on main air fan for cleanliness.
8. Check gas filter or strainers.

Yearly Checklist

1. Test (leak test) safety shut-off valves for tightness of closure.
2. Test pressure switch settings by checking switch movements against pressure settings.
3. Visually check ignition cable and connectors.
4. Check the refractory combustion block to ensure that it is not badly cracked or spalled. Minor hairline cracks are of no consequence and should be considered normal. Examine the refractory around the throat cone, since this area is where breakage can easily occur. If repairs are needed to this area, ensure that any new refractory is installed to the original contours and surface texture.
5. Remove the pilot assembly and examine the ceramic insulators on the spark rods. Clean the spark rod end with a fine emery cloth. Adjust the spark gap to no more than 1/8".
6. Remove the gas gun assembly and clean the gas orifices. Use compressed air to blow all scale or dust out of the ports.
7. Remove the oil gun assembly, and clean the oil injection orifices and atomizing air nozzles according to the instructions that follow in this chapter.

MAINTENANCE PROCEDURES

Fuel Oil Tip Cleaning

Vortometric burner sizes 6V through 12V use an oil nozzle held by a retaining ring. With these sizes, the nose cone assembly must be unscrewed from the body to remove or replace the entire tip.

Vortometric burner sizes 14V and larger use an oil nozzle which is made in two pieces, which allows the outer end of the tip to be removed from the nozzle body. Therefore, the tip head containing the oil orifices can be removed for cleaning without dismantling the entire atomizer.

Note:
On a burner with CLOCKWISE air rotation, the tip head has LEFT HAND threading. On a burner with COUNTERCLOCKWISE air rotation, the tip head has RIGHT HAND threading.

When inspecting and cleaning the fuel oil tips, please observe the following:

- Vortometric oil nozzles are manufactured of stainless steel, with all surfaces manufactured to close tolerances and highly polished. Therefore, avoid marring the nozzle's machined surfaces in any way when the atomizer is dismantled.
- Never use abrasive cleanser or emery cloth on the internal surfaces of the nose cone. However, a wire brush may be used on the outside surfaces of the nose cone where carbon has accumulated.

If the oil tip holes become blocked, you cannot clear the blockage by forcing the atomizing medium through them. Instead, the tip must be removed and cleaned out. Care should be taken when dismantling and cleaning the oil tip to avoid burring or other damage. After removing the tip, the recommended cleaning procedure is as follows:

1. Soak the tip in a solvent such as Varsol, especially if the atomizer has been used with heavy oil.
2. Blow out the tip with compressed air in the reverse direction to the oil flow.
3. Wash the tip again in solvent.
4. Select the correct drill size needed from Table 5.1. **Use a new bit** to avoid potential marring. Insert the drill bit **by hand** into each hole in the oil tip to clear any hard carbon or other residue.

Caution:
Forcing an oversized drill bit into the oil tip holes will ruin the tip.

5. Repeat Step 2.
6. Repeat Step 3.
7. Before reassembling the oil tip in the atomizer assembly, clean out the oil feed pipe with either compressed air or solvent as necessary.

Table 5.1 **Fuel Oil Tip Data**

Burner Size	No. of Holes	Hole Dia. (in.)	Drill Size
6V	4	.0400	60
8V	6	.0400	60
10V	6	.0469	3/64
12V	9	.0430	57
14V	10	.0469	3/64
16V	10	.0550	54
18V	12	.0595	53
22V	12	.0670	51
24V	12	.0730	49
28V	12	.0860	44
32V	12	.0980	40
36V	16	.0980	40

Dismantling of Atomizer

Note:
Refer to Figure 5.1 for oil nozzle component identification and location.

1. Remove the complete oil gun from the burner by removing the bolts on the rear flange of the gun assembly.
2. Place the oil gun in a pipe vise.
3. Loosen the bolts on the packing gland at the rear (outer) end of the oil gun.
4. Using a spanner wrench, loosen the nose cone assembly, which has a standard right hand thread.
5. After freeing the nose cone assembly from the threaded portion of the body, pull the nose cone foward enough to expose the base and tip retaining ring.
6. Using two adjustable wrenches, loosen the retaining ring from the base, then slide the retaining ring back on the fuel pipe to expose the wrench flats on the end of the oil tip.
7. Using an adjustable wrench on the flats of the oil tip, grasp the nose cone assembly and rotate it while pulling it foward. This action separates the nose cone inlet ring and base assembly from the tip. Be careful not to lose or damage the spacer washers.
8. Remove the oil tip by using a pipe wrench on the fuel oil feed pipe and an adjustable wrench on the oil tip flats.
9. Refer to the previous section, "Fuel Oil Tip", for the proper oil tip cleaning procedure.
10. If you need to dismantle the atomizer further, then remove the cap screws and carefully separate the nose cone, inlet ring and base.
11. Wash all parts with a solvent such as Varsol. Wipe all parts clean of any foreign material.

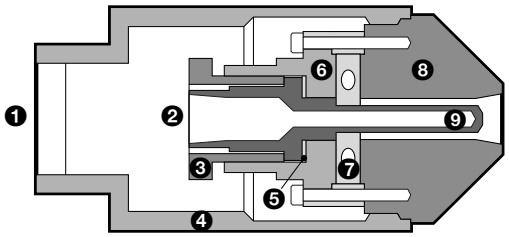
Note:
Due to the tight fit between the oil tip and base, no foreign material can be left on the tip's outside surface OR the base's inside surfaces. Foreign material such as grit can cause scoring of these surfaces and possible binding of the two surfaces. If necessary, a very fine emery cloth may be used to restore them.

12. Referring to Table 5.2, select the correct drill size. Use this drill bit to check the hole diameters of the venturi inlets in the tangential inlet ring. If the holes are worn beyond the corresponding maximum throat diameter number shown in Table 5.2, then replacing the venturi insert should be considered.

13. Examine the flat faces of the base and nose cone, which form the front and rear of the vortex chamber, respectively. Although slight "dimpling" of the surfaces adjacent to the inlet holes is normal, pitting and scoring is not. Clean these surfaces with solvent if they appear oily or sooty.

14. Clean any accumulated carbon from the internal bore of the nose cone, but do not scratch or mar these surfaces.

Figure 5.1 Atomizer Assembly Components



❶ Atomizing Medium Inlet
❷ Oil Inlet
❸ Oil Nozzle Retaining Ring
❹ Body
❺ Spacers
❻ Base
❼ Inlet Ring
❽ Nose Cone
❾ Oil Nozzle

Table 5.2 Atomizing Inlet Ring Data

Burner Size	No. of Inserts	Orig. Insert Throat Dia. (in.)	Orig. Drill Size	Max. Worn Throat Dia. (in.)	Max. Worn Drill Size
6V	6	.0760	48	.0820	45
8V	6	.0995	39	.1093	7/64
10V	6	.1250	1/8	.1360	29
12V	6	.1440	27	.1570	22
14V	6	.1695	18	.1875	3/16
16V	6	.1935	10	.2130	3
18V	6	.2130	3	.2340	A
22V	10	.1960	9	.2130	3
24V	10	.2090	4	.2280	1
28V	10	.2420	C	.2656	17/64
32V	10	.2720	I	.2968	19/64
36V	10	.3020	N	.3320	Q

Assembly of Atomizer

1. With all of the parts clean of foreign material, put a smear of anti-seize compound or similar lubricant on all mating surfaces and on all threads.
2. Slide the retainer ring onto the fuel pipe.
3. Screw the fuel pipe into the oil tip and tighten securely.
4. Assemble the base and inlet ring onto the nose cone using the provided cap screws. Tighten all cap screws securely and evenly. The tangential inlet ring can provide either clockwise or counterclockwise rotation to the steam. However, the steam's rotation direction (as viewed through the rear of the atomizer) MUST match the rotation direction of the air flow through the burner assembly's vanes.
5. Install a new oil tip spacer (standard size of 0.030") on the oil tip, and insert the tip into the atomizer base. Step 7 details what size of spacers should be used to properly locate the oil tip.
6. Tighten the retainer ring securely, using the wrench flats on the ring and on the base.
7. Check the relationship of the oil holes to the nose cone by inserting the specified drill from Table 5.1 into the oil holes as shown at left. The drill's sides should JUST TOUCH the nose cone's lip. If you have trouble inserting the drill into the oil holes, there are two probable causes:
   a. if the drill cannot be inserted easily, then the oil tip is too far back in the nose cone; a thinner spacer is needed so the oil tip can come further forward, or
   b. if there is an obvious space between the drill and the nose cone lip, then the oil tip is too far forward; more spacers are needed to move the tip further back.

   Each atomizer assembly is provided with three spacers of nominal thickness from 0.010" to 0.030"; the 0.030" spacer is the one generally used on the assembly. Depending on your situation, any one or combination of these spacers may be necessary to correctly locate the oil jets.
8. Once the oil tip is correctly located, loosen the packing gland at the outer end of the atomizing steam pipe. Insert the entire atomizer assembly, including the fuel pipe, into the body and atomizing steam pipe.
9. Screw the nose cone assembly into the body threads, being careful not to get it cross-threaded. Tighten the assembly securely with a spanner wrench.

10. Tighten the packing gland at the outer end of the atomizing steam pipe. A final check on the location of the oil holes in relation to the nose cone lip can be done as follows:

a. Connect the oil feed line to a water supply line and spray water out of the nozzle at 5 PSIG.

b. If properly located, then the water streams emerging out of the oil holes should be separate, distinct and uniform; the water streams should also clear the inside lip of the nose cone or just barely touch the lip's edge.

11. Reinstall the oil gun into the burner and connect all hoses securely.

TROUBLE-SHOOTING

Table 5.1 **Trouble-shooting**

PROBLEM	POSSIBLE CAUSE	SOLUTION
Cannot initiate start-up sequence.	Air pressure switch has not made contact:	
	• Air flow too low.	Check air flow and investigate any changes.
	• Air pressure switch incorrectly set.	Check air pressure switch adjustment.
	• Air pressure drop measured incorrectly.	Move pressure taps on chamber to a better location.
	High gas pressure switch has tripped:	
	• Gas pressure too high.	Check incoming gas pressure against initial settings; adjust as required.
	• Gas pressure switch set too low.	Adjust setting to be approximately 4" w.c. above gas pressure.
	Low gas pressure switch has tripped:	
	• Gas pressure too low.	Check incoming gas pressure against initial settings; adjust as required.
	• Gas pressure switch set too high.	Adjust setting to be approximately 4" w.c. below gas pressure.
	Purge cycle not completed.	Check flame safeguard system or purge timer.
	Main power is off.	Make sure power is on to control system.
	No power to control unit.	Call qualified electrician to investigate.
	Malfunction of flame safeguard system:	
	• Flame sensor shorted out.	Check UV sensor and wiring.
	• Electrical noise in sensor line.	Shield or separate sensor lines from high voltage.
	• Unit is broken.	Call qualified electrician to investigate.

TROUBLE-SHOOTING

Table 5.1 **Trouble-shooting**

PROBLEM	POSSIBLE CAUSE	SOLUTION
Start-up sequence runs but pilot does not light.	No spark:	
	• No power to ignition transformer.	Have electrician investigate.
	• Open circuit between the ignition transformer and the spark plug.	Repair or replace wiring to spark plug.
	• Spark plug has carbon build-up.	Clean or replace spark plug.
	• Spark plug not correctly grounded.	Clean spark plug threads. Do not apply grease or pipe compound to pipe threads.
	• Spark plug gap is incorrect.	Set gap to 1/8".
	• Spark is shorting inside pilot pipe	Remove spark plug and clean inside of pipe and star insulators.
	Not enough pilot gas:	
	• Pilot gas regulator set too low.	Check incoming gas pressure against initial settings; increase as necessary.
	• Gas pressure into pilot regulator too low.	Check outgoing gas pressure of main regulator; increase as necessary.
	• Pilot gas cock closed.	Open pilot gas cock.
	• Pilot solenoid valve does not open.	Have qualified electrician check power supply to solenoid.
	• Pilot adjusting valve set too low.	Adjust gas flows to give pressures/ flows indicated on page 4-2.
	• Air in the gas line.	Repeat start-up several times to purge air out of gas lines.
	Too much gas.	Trim pilot gas adjusting valve to give pressures/flows indicated on page 4-2.

TROUBLE-SHOOTING

Table 5.1 Trouble-shooting

PROBLEM	POSSIBLE CAUSE	SOLUTION
Start-up sequence runs, pilot lights but main burner does not light.	No UV signal.	Check wiring and control logic.
	Not enough main fuel:	
	• Main fuel regulator set too low.	Check outgoing fuel pressure of main regulator; increase as necessary.
	• Fuel pressure into main regulator too low.	Check incoming fuel pressure against initial settings; increase as necessary.
	• Main fuel cock closed.	Open all fuel cocks.
	• Main safety shut-off valve does not open.	Have qualified electrician check power supply and safety circuitry.
	• Main fuel control valve set too low.	Adjust fuel flows to give pressures indicated in Appendix.
	• Air in the gas line.	Repeat start-up several times to purge air out of gas lines.
	• No fuel oil to nozzle.	Repeat start-up several times to fill oil lines and nozzle. Reduce piping length if necessary.
	Too much gas.	Trim control valve to give pressure indicated in Appendix.
Pilot ignites but flame safeguard shuts down burner.	No UV signal.	Check wiring and control logic. Adjust position of UV sensor with swivel mount.
Burner kicks out shortly after start-up.	Low main fuel pressure switch is set too high.	Check and reset low pressure switch setting.
The low fire flame is weak and unstable.	• Not enough fuel.	Check start-up settings and adjust to increase fuel flow.
	• Too much air.	Check combustion air pressure drops/ flow across the burner and adjust.
Burner does not go to high fire.	• Not enough fuel pressure into main fuel regulator.	Adjust pressure regulator so pressure is provided at burner as specified in this manual.
	• Fuel pressure drops as input is increased.	Check for clogging of valves and regulators in fuel line.
	• Main fuel control valve is not functioning.	Check actuator and linkage.
Main flame is uneven and not centered in the refractory block.	• Incorrectly positioned gas/oil gun.	Ensure gas/oil gun is centered within the throat cone.
Main flame pulsates or is unstable.	• Unstable air flow.	Check blower/air system for pressure pulsations.
	• Unstable fuel flow.	Check pressure regulator and control valve for pulsations.
	• Pilot gun inserted too far.	Pull back pilot gun.

TROUBLE-SHOOTING

Table 5.1 **Trouble-shooting**

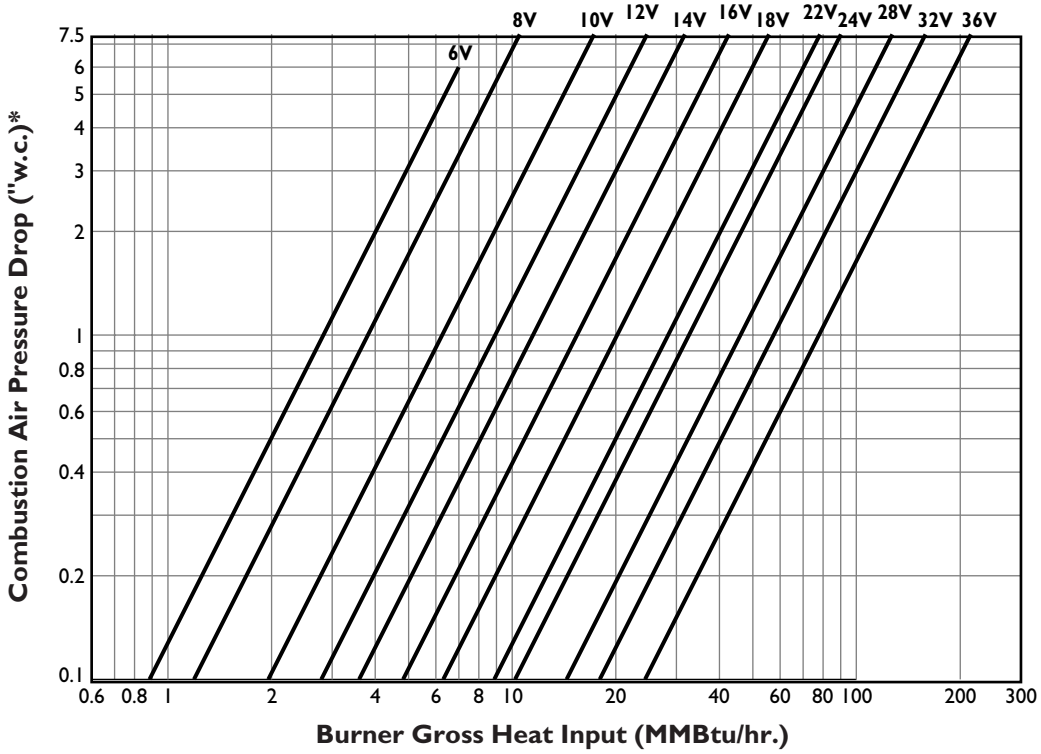
PROBLEM	POSSIBLE CAUSE	SOLUTION
Main flame is too large at high fire.	• Fuel pressure too high at burner inlet.	Check fuel pressure against design. Adjust main fuel pressure regulator, or adjust control valve.
	• Combustion air pressure drop/flow is too low.	Open air damper on main air blower.
Main flame does not achieve capacity.	• Combustion air pressure drop/flow is too high.	Check pressure drop or flow. Check air damper on main air blower.
	• Burner is firing below rated input.	Check fuel pressure differential/flow. Adjust main fuel pressure regulator as necessary.
	• Burner gas holes/oil ports are plugged.	Inspect holes/ports for blockage; clean as needed.
Main flame is yellow and long (in gas applications) OR Main flame appears a dull orange color (in oil applications).	• Air pressure drop/flow is lower than design.	Check pressure drop or flow. Open air damper on main air blower.
	• Windbox air flow is restricted.	Inspect windbox and blower to ensure that no foreign material is restricting the air flow.
Main oil flame is white and hard.	Too much air.	Check combustion air pressure drop/ flow. Close control damper as necessary.
Uneven oil flame with stingers shooting out to one side of the block.	Orifices in the oil tip are plugged.	Remove oil nozzle and clean as necessary.
Orange or red "sparklers" in the oil flame.	• The oil is too cold.	Check oil heating system; increase temperature as necessary.
	• The atomizing medium pressure is too low.	Check existing atomizing pressure versus required (see table in Appendix).
Flame temporarily becomes black and smokey, then clears up again OR Flame sputters and goes out momentarily.	Moisture (condensate) in the atomizing medium.	Ensure that the condensate trap is operating properly for atomizing steam. Install dryers in the atomizing air line.
Fiery ring of burning oil on the inside diameter of the combustor surface OR Carbon deposits on the inside of the refractory block.	Poor atomization.	Check atomizing pressure and adjust as necessary. Check oil nozzle ports for clogging.
Carbon accumulation on the oil nozzle cone.	Oil nozzle is too far forward into the throat.	Move gun back 1/4" at a time until carbon no longer accumulates.

Appendix

FLOW AND INPUT CHARTS

Table A.1 Combustion Air Pressure Drop vs. Burner Heat Input for Medium Intensity Burners (MI)

- Operation with 15% excess air on natural gas under standard conditions (14.7 psia @ 70°F).
- Pressure drop should be taken between the chamber and windbox pressure tap.



* 7.5"w.c. is the nominal design pressure drop for all models, except for model 6V of the medium intensity burners.

Table A.2 Combustion Air Pressure Drop vs. Burner Heat Input for High Intensity Burners (HI)

- Operation with 15% excess air on natural gas or #2 oil under standard conditions (14.7 psia @ 70°F).
- Pressure drop should be taken between the chamber and windbox pressure tap.

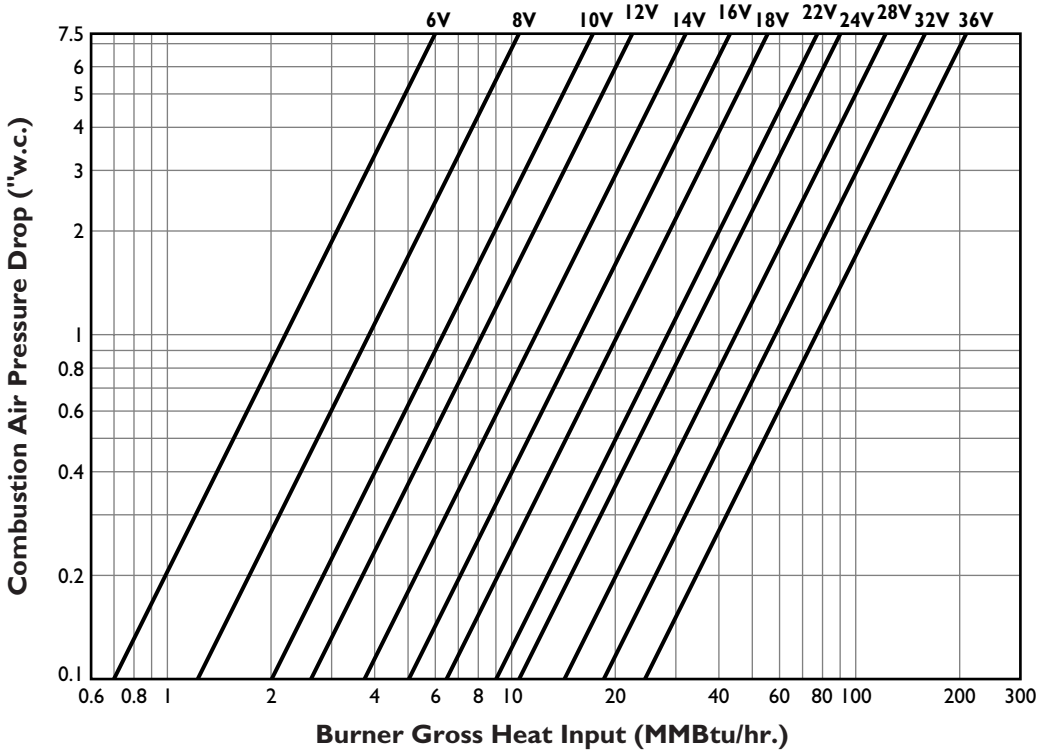
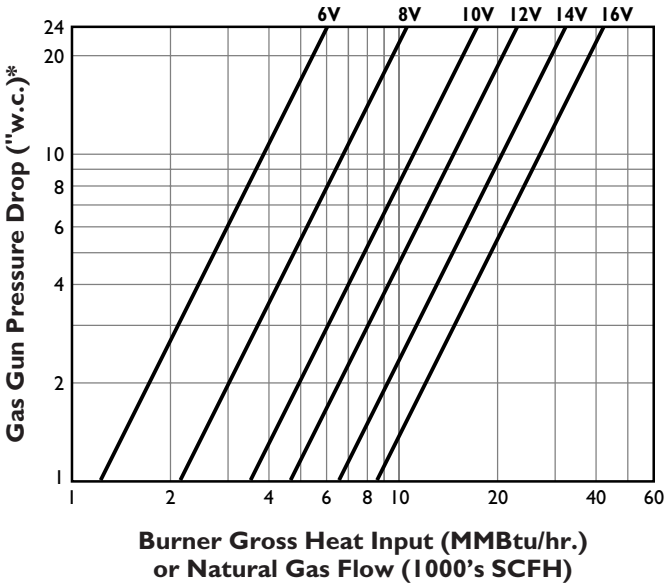
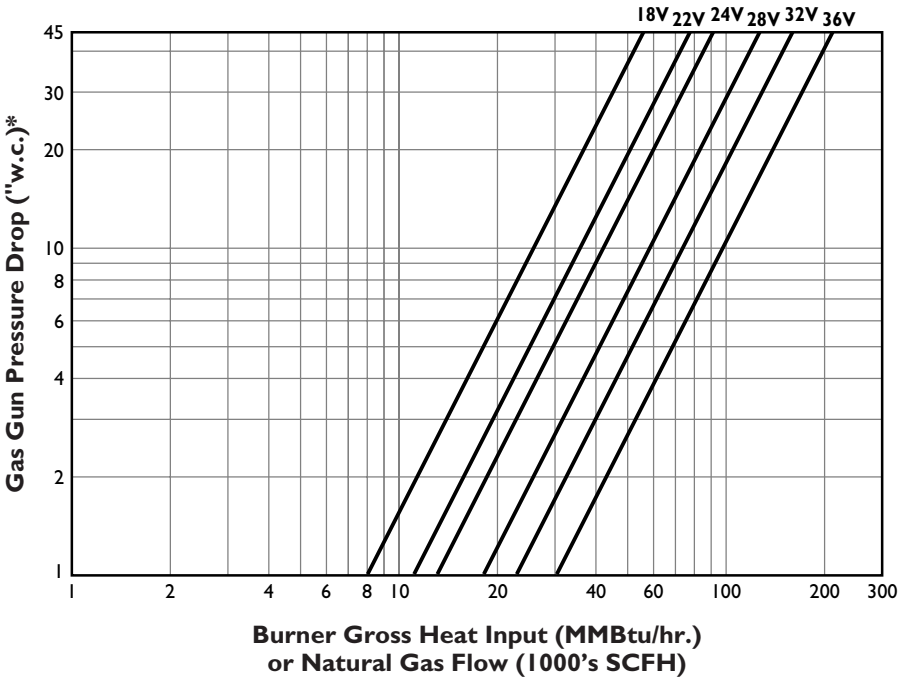


Table A.3 Gas Gun Press. Drop vs. Burner Heat Input

- Pressure drops for natural gas, 1,000 Btu/SCF gross, 0.6 specific gravity.
- Pressure drop should be taken as differential between the chamber and gas gun pressure tap.

Note:
Fuel pressure drop curves should be used as a guide for setting up burner. It is recommended to use a direct fuel flow measurement (orifice plate or flow meter) for calculating actual fuel flows.





* Nominal pressure drop at maximum capacity is 24"w.c. for 6V through 16V models, and 45" w.c. for all other models.

Table A.4 Oil Nozzle Press. Drop vs. Burner Heat Input

- Pressure drops for #2 Oil with 137,000 Btu/lb. gross heating value.

Note:
Fuel pressure drop curves should be used as a guide for setting up burner. It is recommended to use a direct fuel flow measurement (orifice plate or flow meter) for calculating actual fuel flows.

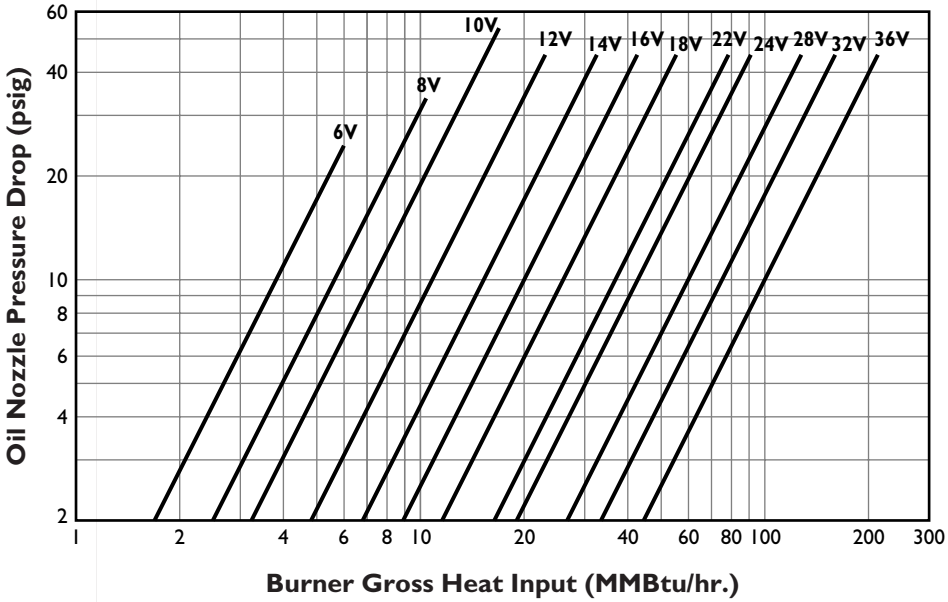


Table A.5 Atomizing Air Pressure Drop vs. Air Flow

- When air is used for atomization of heavy oil, it should be preheated to approximately the same temperature as the oil.

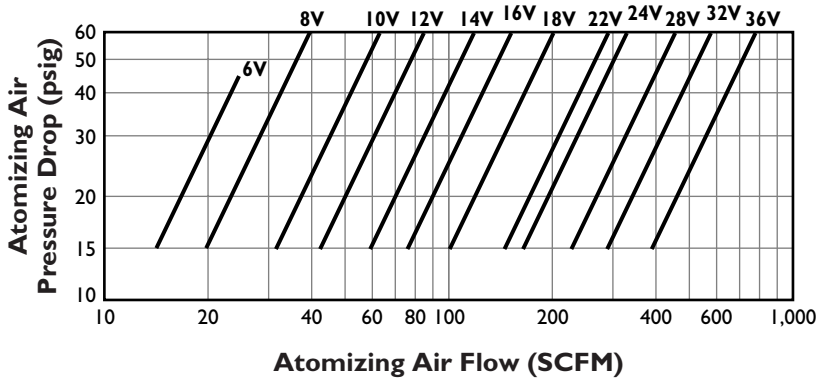
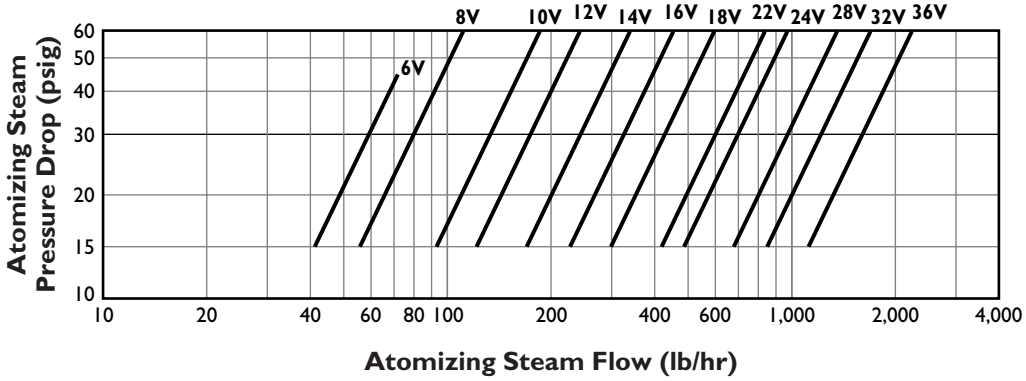


Table A.6 Atomizing Steam Press. Drop vs. Steam Flow

- Atomizing steam must be dry and superheated a minimum of 20°F above saturated at the atomizer inlet.



RECOMMENDED SPARE PARTS

To make sure that the downtime of the system is as short as possible in case of a failure, you should keep a stock of spare parts.

Recommended spare parts

PART NAME	QTY.	PART NO.
Pilot assembly	1	❶
Spark rod assembly	1	❶
Oil gun assembly	1	❶
U.V. scanner (if used)	2	❷
1-1/4" N.P.T. peepsight glass	2	13046
1-1/4" N.P.T. peepsight gasket	2	13047

❶ Part number varies depending on burner size used.
❷ Part number varies depending on U.V. scanner used.

CONVERSION FACTORS

Metric to English.

FROM	TO	MULTIPLY BY
cubic meter (m^3)	cubic foot (ft^3)	35.31
cubic meter/hour (m^3/h)	cubic foot/hour (cfh)	35.31
degrees Celsius (°C)	degrees Fahrenheit (°F)	(°C x 1.8) + 32
kilogram (kg)	pound (lb)	2.205
kilowatt (kW)	Btu/hr	3414
meter (m)	foot (ft)	3.28
millibar (mbar)	inches water column ("wc)	0.401
millibar (mbar)	pounds/sq in (psi)	14.5×10^{-3}
millimeter (mm)	inch (in)	3.94×10^{-2}

Metric to Metric.

FROM	TO	MULTIPLY BY
kiloPascals (kPa)	millibar (mbar)	10
meter (m)	millimeter (mm)	1000
millibar (mbar)	kiloPascals (kPa)	0.1
millimeter (mm)	meter (m)	0.001

English to Metric.

FROM	TO	MULTIPLY BY
Btu/hr	kilowatt (kW)	0.293×10^{-3}
cubic foot (ft^3)	cubic meter (m^3)	2.832×10^{-2}
cubic foot/hour (cfh)	cubic meter/hour (m^3/h)	2.832×10^{-2}
degrees Fahrenheit (°F)	degrees Celsius (°C)	(°F − 32) ÷ 1.8
foot (ft)	meter (m)	0.3048
inches (in)	millimeter (mm)	25.4
inches water column ("wc)	millibar (mbar)	2.49
pound (lb)	kilogram (kg)	0.454
pounds/sq in (psi)	millibar (mbar)	68.95

SYSTEM SUMMARY

Write down the settings for the burner system in the table that follows:

GENERAL SYSTEM PARAMETERS	BURNER SETTINGS	
	HIGH FIRE	LOW FIRE
Customer:	Main gas pressure:	
Customer P.O.:	Air pressure from the blower:	
Customer signature:	Air pressure drop across the burner:	
Date:	Gas pressure drop across the burner:	
Furnace type:	Main oil pressure:	
Furnace temperature:	Oil pressure across the burner:	
Number of burners:	Atomizing pressure:	
High fire input per burner:	Atomizing pressure drop across the burner:	
Orifice sizes:	Flame signal strength:	
Operating voltage & frequency:	Flame length:	
Altitude:		

Offered By:
Power Equipment Company
2011 Williamsburg Road
Richmond, VA 23231
Phone: 804-236-3800 Fax: 804-236-3882

www.peconet.com